VAISALA / APPLICATION NOTE

Eight Things to Consider When Choosing an Outdoor Humidity Instrument

Outdoor humidity and temperature measurement is essential for applications such as energy management and indoor climate control. Just one outdoor humidity sensor typically optimizes the energy efficiency of cooling equipment. However, if this sensor is not accurate, both energy efficiency and human comfort may be compromised.

Use a Professional Solar Radiation Shield

When measuring outdoor humidity, the measurement instrument is exposed to sunlight. Without a proper solar radiation shield, temperature and humidity readings get distorted. Erroneous measurements provide no value to the control system and reduce energy savings.

Accurate readings can only be obtained when using a professional radiation shield. The shield protects the temperature and humidity sensor from rain and solar radiation, whether it's direct or scattered.

Guidelines for Installing Outdoor Humidity Instruments

- Avoid areas near exhaust fans or shaded areas that may affect measurements
- Locate sensors away from heat and moisture sources
- Avoid locations where air circulation is obstructed by structures or equipment
- Use a radiation shield to protect the sensor from precipitation and solar radiation
- Use a suitable installation kit for pole-mast installations on cooling towers or rooftops

Eight Things to Remember When Choosing an Outdoor Humidity Instrument

1. Ensure that the instrument works even in your most demanding conditions. The operating temperature range should be from -40 to 60°C (-40 to 140°F) and the instrument should measure the full 0 to 100% RH range.
2. Never purchase a humidity sensor for outdoor measurements without a proper radiation shield.
3. The radiation shield should be designed for use with your specific humidity sensor to ensure optimal performance.
4. The radiation shield can be made of either metal or plastic, but it should have low thermal conductivity, high reflectivity, good corrosion resistance, UV durability, and resistance to dirt accumulation.
5. The enclosure should protect both the electronics and the humidity sensor from rainwater, dust, and dirt.
6. Consider installation accessories and ease of installation for your selected installation site: pole, horizontal beam, flat surface, or wall.
7. Ensure the sensor can recover rapidly from condensation for undisturbed operation outdoors.
8. Make sure that the humidity sensor can be easily calibrated according to your needs – either on-site without detaching the instrument or off-site at a calibration facility.

Temperature Dependency – the Challenge of Outdoor Humidity Measurement

Relative humidity (RH) measurement is a temperature-dependent parameter. RH can be defined as the ratio of the partial water vapor pressure (Pw) to the water vapor saturation pressure (Pws) at a particular temperature:

$$\%RH = 100\% \times Pw / Pws$$

As the denominator in the definition (Pws) is a function of temperature, relative humidity is strongly temperature dependent.

For example, at 20°C and with a relative humidity of 50%, increasing the temperature to 25°C will decrease RH to about 37%, even though the partial pressure of the water vapor remains the same. This shows how important it is to understand the conditions in the measurement environment when striving for accurate and reliable humidity measurements.

The Elements of a Good Radiation Shield

Radiation Shield Material:

- Non water-absorbing
- Dirt and corrosion resistant
- Low thermal conductivity
- UV proof

Functional Design

- White external surface that efficiently reflects solar radiation
- Black inside to absorb accumulated heat and scattered solar radiation
- Efficient air flow to sensor due to its uniquely profiled and naturally ventilated multiple disc structure
- No moving parts – requires no maintenance

The Most Common Humidity Parameters Used in Free Cooling

Parameter	Description
Dew point	When a gas is cooled and gaseous water vapor begins to condense in the liquid phase, the temperature has reached the dew point temperature (Td). Thus at 100 %RH the ambient temperature equals the dew point temperature. The more negative the dew point is from the ambient temperature, the smaller the risk for condensation and therefore the drier the air. Unlike relative humidity, dew point is not temperature dependent but it is affected by pressure.
Wet bulb temperature	Traditionally, the wet bulb temperature (Tw) is the temperature indicated by a thermometer wrapped in a wet cotton sheath. In air conditioning applications, the wet bulb temperature is compared to the dry bulb temperature to determine the cooling capacity of evaporative coolers.
Enthalpy	Enthalpy is defined as the amount of energy required to bring a gas to its current state from a dry gas at 0°C. The specific enthalpy of moist air is defined as the total enthalpy of dry air (sensible heat) mixed with the water vapor (latent heat) per unit mass of moist air. The value is calculated as the difference to the selected reference state. For metric units (kJ/kg), the reference state is dry air at 0°C. For non-metric units (Btu/lb), the reference state is dry air at 0°F. Enthalpy is used in air conditioning calculations.

Vaisala Outdoor Humidity Instruments

Vaisala has over 75 years of experience in professional weather measurement, and our outdoor instruments have been tested in the most demanding conditions to ensure reliable operation. Explore our full portfolio of HVAC outdoor instruments at **www.vaisala.com/HVAC.**

We are happy to help you with any questions you might have about measuring outdoor humidity and temperature. Find your local contact at **www.vaisala.com/contact.**